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U N I T E D S T A T E S A T O M I C E N E R G Y C O M M I S S I O N

THE INHALATION TOXICITY OF SODIUM ACID SULFATE MIST
AT 75 MG/M3 IN ANIMALS

by

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THE INHALATION TOXICITY OF SODIUM ACID SULFATE
MIST AT 75 MG/M³ IN ANIMALS

Abstract

Because the current literature contains reports⁽¹⁾ that throw doubt on the toxicity of beryllium per se and point instead to the putative toxicity of the acidic ions of its salts, especially sulfate and fluoride, an inhalation study of sodium acid sulfate mist was performed to determine whether the sulfate ion had a toxicity comparable to that of beryllium sulfate. Accordingly, an inhalation experiment was performed in which the conditions of exposure duplicated those in which beryllium sulfate had been used as the toxic agent except that in the present study, sodium acid sulfate solution, with a pH of 1.7, had been substituted for the beryllium salt solution. Twenty guinea pigs and 10 rats were exposed daily for more than 2 weeks to 75 mg/m³ of the acid sulfate salt. This treatment produced no general weight loss in either species. In one rat and 2 guinea pigs that died from causes apparently unrelated to the exposure, however, some weight loss occurred. No lesions were observed in any animal that could be attributed to the exposure of the NaHSO₄ mist, either in small groups of animals killed 10 days from the start of exposure or in the remainder of the exposed animals killed 16 days after the termination of the exposure. In a small number of rats and guinea pigs, the rather common findings in these species of atelectasis was made. Some bronchial epithelium proliferation, similar to that seen in the beryllium sulfate inhalation study, was occasionally seen in the guinea pig. It was concluded, however, that the sulfate ion, under the conditions of inhalation used for beryllium sulfate exposure at high concentrations, does not produce appreciable toxicity in rats or guinea pigs and it may be inferred therefore, that since inhaled beryllium sulfate at this concentration is

not only toxic but lethal, beryllium ion produces these effects.

signed George Sprague
George F. Sprague

INHALATION TOXICITY STUDY OF SODIUM ACID SULFATE
MIST AT 75 MG/M³ IN ANIMALS

INTRODUCTION

The purpose of the present study was to determine the role, if any, of the sulfate ion in producing the pulmonary changes seen in laboratory animals exposed to beryllium sulfate mist. In order to investigate this problem, 10 rats and 20 guinea pigs were exposed to $\text{NaHSO}_4\text{-H}_2\text{SO}_4$ mist at a mean concentration of 75 mg/m³ for a total of 82.5 hours over a 17-day period, an interval corresponding to that used in the beryllium sulfate exposure.

MATERIALS AND METHODS

Exposure Chamber and Feed. The animals were exposed in the same unit that was used for the beryllium sulfate mist study at 100 mg/m³. The dimensions of this unit were 81.5 cm x 81.5 cm x 76 cm high. The specific gravity and the pH of the NaHSO_4 solution were adjusted to conform with that used in the beryllium study. Sulfuric acid was used to obtain a pH of 1.7. The $\text{NaHSO}_4\text{-H}_2\text{SO}_4$ solution was placed in a 4-jet aerosol generator⁽²⁾ which dispersed the solution throughout the unit as a fine mist. This type of feed was likewise identical with that used in the beryllium sulfate mist study at 100 mg/m³.

Chamber Data. During the exposure period the mean concentration of $\text{NaHSO}_4\text{-H}_2\text{SO}_4$ for all samples, as determined gravimetrically using filter paper samples, was 75 mg/m³ of air with a standard deviation of 24 mg/m³ of air. The mean temperature and relative humidity in the chamber during this period were 72.7°F ± 2.5° and 57.9% ± 7.5% respectively.

Toxicologic Procedures. Three rats and 4 guinea pigs were sacrificed on the 10th calendar day and the remainder on the 14th day following the

termination of exposure. The animals were weighed once weekly throughout the 2-week conditioning period, the 2-week exposure period and the 2 weeks post-exposure, follow-up period. Selected tissues from all sacrificed animals were submitted for histologic study.

RESULTS

Mortality. One rat died on the 32nd calendar day, 13 days following the termination of exposure. There were 2 deaths among the guinea pigs, 1 on the 1st calendar day and 1 on the 23rd calendar day, 4 days post-exposure. Autolysis in all 3 animals rendered them unfit for histologic examination.

Weight Response. All animals were weighed weekly throughout the study. Weight loss was observed only in the rat and in the 2 guinea pigs that died.

Pathology (Dr. J. Scott and staff). Three rats and 4 guinea pigs were sacrificed on the 10th day after the start of the experiment. The remaining animals, except 1 rat and 2 guinea pigs that died, were sacrificed 14 days after the termination of exposure. Sections for histologic study were taken of lung, liver, kidney and any other organs which appeared abnormal in the sacrificed animals.

No pulmonary changes were observed which could be attributed specifically to NaHSO_4 inhalation. The sections of liver, spleen and kidney from all animals were essentially normal. There were no significant differences in the findings in the two sacrificed groups, either at 10 days after the start of exposure or 14 days after its termination.

Guinea Pig. Small amounts of atelectasis and congestion were found in the lungs of 3 guinea pigs but these are common findings in unexposed animals of this species. An interesting finding in one pig was that of bronchial epithelial proliferation frequently seen in the beryllium sulfate

inhalation studies. Thoracic, mesenteric and cervical lymph nodes from 3 guinea pigs revealed scattered foci of acute suppurative inflammation. In general, however, there were no lesions considered to be attributable to the sulfate exposure.

Rat. The lungs of 2 rats revealed atelectasis and congestion to a slight degree. In 3 other rats a subacute bronchitis and bronchopneumonia were evident.

SUMMARY

1. The inhalation toxicity of $\text{NaHSO}_4\text{-H}_2\text{SO}_4$ mist at 75 mg/m^3 was determined in the rat and guinea pig.
2. The body weight loss was observed in but 3 of 30 animals.
3. No pulmonary changes were consistently observed which could be attributed specifically to the sulfate ion. Bronchial epithelial proliferation frequently seen in beryllium sulfate inhalation studies was found in 1 of 18 guinea pigs.
4. It is concluded that sulfate ion per se under the conditions of inhalation used comparable to those set in a high-grade beryllium sulfate exposure is not appreciably toxic to rats, a susceptible species to beryllium sulfate or to guinea pigs which are less susceptible.

REFERENCES

1. Fairhall, L.T., The Toxicology of Beryllium, Nat'l Inst. of Health, Bulletin #181, U.S. Govt. Printing Office, 1943.
2. Rochester Area Report #UR-6.